Livestock disease risk tied to herd management style

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Credit: Penn State

A new study provides an updated picture of the prevalence of the sheep and goat plague virus (PPRV), a widespread and often fatal disease that threatens 80 percent of the world's sheep and goats, in northern Tanzania.

According to the research team, livestock managed in a system where they are the sole source of an owners' livelihood are more likely to become infected with PPRV than livestock managed in a system where the owners' livelihood is supplemented by agriculture. Additionally, the presence of cattle may affect infection risk, even though they are not typically considered important hosts for the virus.

The new study, by researchers at Penn State, the University of Glasgow, and the Nelson Mandela African Institute of Science and Technology, appears online in the journal *Epidemiology and Infection*.

"About 330 million people worldwide rely on sheep and goats for their livelihood, so understanding how major livestock diseases spread is critical," said Catherine Herzog, epidemiologist, current graduate student at Penn State, and first author of the paper. "Peste des petits ruminants virus (PPRV), also known as sheep and goat plague virus, has been reported in over 70 countries in Asia, the Middle East, and Africa, threatening about 80 percent of the world's population of sheep and goats. In this study, we provide an up-to-date look at the prevalence of PPRV in northern Tanzania and explore factors that affect how the disease is transmitted."

PPRV typically kills 50 to 80 percent of the sheep and goats it infects. Those that survive contain antibodies in their blood that recognize the virus and prevent future infection. These antibodies are used by researchers as an indicator of past infection.

The researchers surveyed livestock across villages in northern Tanzania for evidence of past infection, comparing rates in herds from pastoral villages, where people rely almost solely on livestock, and from agropastoral villages, where people rely on a mix of livestock and agriculture.

"According to our models, herds from pastoral villages had 3.8 times the risk of becoming infected and developing detectable antibodies compared to those from agropastoral villages," said Herzog. "If you look only at a herds of sheep or only at herds of goats instead of mixed-species herds, that risk increases to 9.4 or 9.5 times higher, respectively, for pastoral systems when compared to agropastoral systems."

Female sheep and goats also had 1.5 times higher risk of becoming infected than males. Understanding prevalence and infection risk could improve the researcher's ability to predict how the disease will spread and to refine management techniques to minimize disease risk.

"Next we plan to investigate which aspects of the livestock management system within a pastoral herd may be driving this increased risk," said co-author Ottar Bjørnstad, Distinguished Professor of Entomology and Biology and J. Lloyd and Dorothy Foehr Huck Chair of Epidemiology at Penn State, who led the research team. "For example, herd size, herd age structure, contact rates among livestock and wildlife, and access to veterinary service may all play a role in infection risk. Knowing which animals are at greater risk of infection may affect how we allocate resources to manage prevention strategies."

Although PPRV is generally considered to be a sheep and goat virus, the research team also considered cattle in their surveys and analysis.

"Cattle are often managed alongside sheep and goats and can become infected, although it is unclear if cattle can transmit the disease," said Herzog. "We found that the rate at which animals become infected—force of infection—was related between sheep and cattle and between goats and cattle. This is consistent with the idea that cattle play a role in transmission to sheep and goats, or, alternatively, that an unknown external factor is affecting transmission in each species in a similar way."

"To further explore the role of cattle in transmission, we plan to perform experimental transmission trials with all three species with our collaborators in Ethiopia, who also work with us on bovine tuberculosis projects," said co-author Vivek Kapur, Associate Director for Strategic Initiatives at the Huck Institute of the Life Sciences, Huck Distinguished Chair in Global Health, and Professor of Microbiology and Infectious

Disease at Penn State. "Understanding if cattle can transmit to sheep or goats ahead of the upcoming global eradication campaign is a top priority."

PPRV is considered an attractive target for eradication due to its socio-economic importance and the availability of a vaccine, which provides protection for sheep and goats from the disease for up to 3 years.

"PPRV is not too unlike rinderpest in cattle—one of only two viruses that we have completely eradicated from the planet, thanks in part to good vaccines," said co-author Peter Hudson, Willaman Professor of Biology at Penn State. "But sheep and goats live shorter lives than cattle, and there are more of them, so it can be a challenge for herd owners to keep up with vaccination. We hope our work will clarify the ecological mechanisms driving PPRV transmission, allowing us to improve vaccination accessibility for at-risk herds and optimize other prevention strategies."

More information: C. M. Herzog et al, Pastoral production is associated with increased peste des petits ruminants seroprevalence in northern Tanzania across sheep, goats and cattle, *Epidemiology and Infection* (2019). DOI: 10.1017/S0950268819001262

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